γ-π^0 Discrimination in the Electromagnetic Calorimeter of the ALICE experiment at the LHC

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Hard processes occur early in heavy-ion collisions, hence they are considered to be good probes of the dense medium created in the early stages of the collisions. Jets are one of the proposed hard probes. These interact strongly with the medium, which means that measuring their energy loss will provide information about the properties of the medium and possibly the parton density.

In order to quantify the energy loss of hard partons in the medium, one would like to measure the fragmentation function of jets, i.e the distribution of the fractional energy between particles [1]. The fragmentation function depends both on the momentum of individual particles and the total energy of the jet. Due to the large background fluctuations inherent in LHC collisions, it is necessary to use small cone radii to find the jets, but this decreases the energy resolution [2]. This is where γ-jet processes become very useful [1]

In a γ-jet process the total energy of the jet will be nearly equal to that of the photon emitted in the opposite direction. The photon does not interact with the medium and therefore provides direct information about the unquenched jet energy. The calibration of jet energy measurements will be possible using γ-jet processes.

The predominant source of background to direct photons comes from the two photon decay of π^0's. This background is expected to be an order of magnitude greater than the signal, which means that an efficient π_0 cut should be developed that ensures a high purity photon signal. There are three methods that can be used to discriminate between π^0's and photons: invariant mass analysis, shower shape analysis and isolation cut [3].
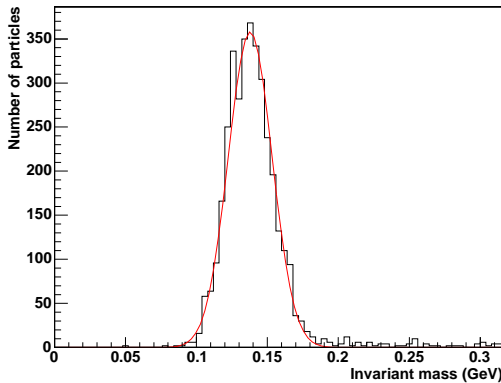

FIG. 1: The invariant mass peak obtained for 5000 π^0's with energies between 1 and 6 GeV, which produced separated clusters in the EMCal

For π^0's, which have energy below 6 GeV, the two photons form separate clusters in the EMCal. The π^0's can be identified and using invariant mass analysis, as illustrated in Figure 1, and rejected from the data sample.
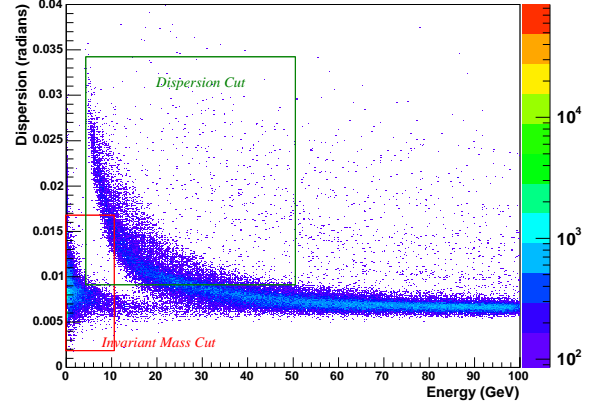

FIG. 2: Dispersion of π^0's showing the energy regions in which different analyses will be required.

Once the energy of the π^0 becomes greater than 6 GeV, the two photons form one cluster, but the cluster is large and not circular. In this region shower shape analysis can be used. The most important parameter is the dispersion [4], which can be used to discriminate between photons and π^0's from 6 GeV to 40 GeV (see Figure 2).

Another important parameter is the sphericity, which measures how much the cluster shape deviates from a circle. A cluster that is made from two photons will have an oval shape in comparison to one from a single photon, which will be circular.

Above 40 GeV the decay photons from the π^0's merge into one cluster and hence appear identical to single photons. Most high energy π^0's are part of a jet, which means that an isolation cut can be used to reject them. A cluster is rejected as a photon candidate if there are other particles within a certain radius of it.

The analysis presented here is still in progress.

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